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# DISMOUNTABLE IONIC X-RAY TUBE FOR STRUCTURAL ANALYSIS

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Soviet experts have devoted considerable attention to the development of new X-ray tubes. (1-5) Most tubes perfected are of a specialized, high-powered type, complex in both their manufacture and application, or tubes requiring special apparatus for making the X-ray photographs.

The All-Union Conference on the Application of X-rays to Materials Research meeting in Leningrad in 1948 noted the great need for perfecting an ionic X-ray tube for structural analysis in place of previously used tubes (6).

In structural analysis it is necessary to obtain the greatest possible concentration of X-rays in order to cut down the exposure time. If the tube is of normal power this increased intensity of X-rays may be achieved by: (1) attaining a sharp focus of the tube (2-1 mm), and (2) decreasing the distance between the window of the tube and the focal point to a minimum. Features of existing conventional tubes prevent or limit the achievement of a sharp focus. V. I. Danilov (7) describes a modification which will permit movement of the focusing unit without disassembling the tube, but it is adaptable only for experimentation.

In addition to simple design and high radiation intensities, an ideal X-ray tube should provide simple centering of the cathode with respect to the anticathode, different types of radiation, easy assembling and disassembling of the tube, reliable vacuum with a minimum of sealing material, and rapid operation.

In this connection, the new tube design proposed by us has the following characteristics: (1) a smaller distance between the anode mirror and the outside window, (2) simple and convenient focus control without disassembling the tube or disturbing the vacuum, (3) provision for easy adjustment of the cathode position in relation to the anticathode while the tube is in use, without disturbing the vacuum, (4) radiation intensity control while the tube is in use, without



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disturbing the vacuum, (5) the least amount of vacuum sealing material, (6) small-sized tube housing, (7) a simpler cooling system than in tubes of the "Khadding" type, and (8) a simpler type of cathode insulator. Construction details are as follows.

The tube has three aluminum windows sealed with a mixture of beeswax and rosin in equal amounts. The distance from the outer surface of the window to the center of the anode mirror is 9 mm; in the "Khadding" tube this distance is 20 mm. The anticathode is inserted at one side of the tube perpendicular to the cathode axis to permit control of the amount of radiation by its manipulation. Surfaces of the tetrahedral anticathode measure 6 x 6 mm, and each has a corresponding anode mirror of 0.1-mm thickness, thus obtaining four different radiations. The tube casing and the anticathode have nozzles for water cooling.

The casing and cathode insulator are connected with an adjustable device by which the cathode may be centered and the interval between it and the anode varied in the range of 70-90 mm. This device consists of a corrugated metal tube ("sil'fon"), a flange, and the regulating screws. The lower end of the silfon is soldered to the tube casing and the upper end to the flange. Regulating screws control the position of the cathode with relation to the anticathode.

The focusing device consists of a nut and sleeve with its lower part soldered to the cathode tube. A tight-fitting aluminum tube (focusing cylinder) is attached to the lower end of the nut, and a stopper is provided to control the raising and lowering of the nut. To change focus, it is sufficient to cut off the high voltage and turn the sleeve the necessary number of rotations (each turn raising or lowering the cathode 1 mm with a variation of 15 mm possible). An adapter, soldered to the cathode tube, turns the cathode. Rubber washers and the sleeves maintain the vacuum and a water cooling chamber used in medical X-ray tubes is attached to the cathode tube. The cathode insulator is a porcelain tube 30 mm long, glazed on both sides, with outer and inner diameters of 50 and 40 mm, respectively. It is supported by two flanges fastened on with litharge nuts.

The tube is ready to operate 1-2 hours after the assembling is started. On following days the starting time is determined only by the starting time of the high-vacuum pump. With a steam-oil, glass pump, stable operation is obtained in 5-7 minutes.

Exposures made with a 2-mm focus gave the following results: A Debye-gram of a copper specimen 0.9 mm in diameter (at 10 ma and 30 kv) was prepared in 5 minutes in a Debye chamber with a diameter of 57.3 mm (the distance from the focus to the specimen was 69 mm).

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